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**ASSESSMENT OF GROUND WATER
QUALITY IN THE VICINITY OF THE
HIMCO LANDFILL SITE,
ELKHART, INDIANA**

Prepared for

Bayer Corporation
Elkhart, Indiana

Prepared by

ENVIRON International Corporation
Arlington, Virginia

June 26, 1996

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I. EXECUTIVE SUMMARY

In September 1995, well water samples were collected by the U.S. Army Corps of Engineers ("USACE") from 19 wells at and near the Himco Landfill site in Indiana ("the Site"). Sampling locations included seven existing monitoring wells, four new upgradient monitoring wells installed north of the landfill, six new downgradient monitoring wells installed south of the landfill, and two new monitoring wells installed along the eastern boundary of the Himco Landfill site in Indiana. The samples were analyzed for metals, cyanide, volatile organic compounds (VOCs), semi-volatile compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs), yielding over 100 analytes per sample. ENVIRON Corporation has reviewed these analytical data. The scope of ENVIRON's review and ENVIRON's findings regarding ground water quality conditions on and near the Site are presented in this report.

ENVIRON conducted a quality assurance review of these new sampling data using guidelines developed by the U.S. Environmental Protection Agency ("USEPA" or "Agency") for the Contract Laboratory Program. The validated USACE data were compared to analytical data obtained by EIS Environmental Engineers, Inc. (EIS) using split samples that were provided by the USACE. No major differences were noted between EIS' and USACE's results.

The frequency of detection and range of detected concentrations in the two ground water sampling events (totalling 48 well water samples) were tabulated for the 27 carcinogens and nine non-carcinogens that contributed most to risk measures (i.e., lifetime cancer risk, or LCR, and non-cancer Hazard Quotient, or HQ, respectively) calculated by Life Systems, Inc. ("LSI") in the baseline health risk assessment for the Site. These 36 substances of potential concern included every carcinogen evaluated by LSI that yielded a LCR value of one per million (1×10^{-6}) or greater and every non-carcinogen evaluated by LSI that yielded a HQ value of 0.1 or greater, based upon LSI's exposure assumptions. ENVIRON evaluated the frequency of detection and the magnitude and spatial pattern of detected concentrations of each of these substances to identify which ones may be related to past landfilling operations at the Site. Only substances that were detected in downgradient wells at a frequency of detection of 10% or greater (once or more every 10 samples) and at elevated concentrations, relative to upgradient (background) ground water samples, were judged to be site-related chemicals of

potential concern in ground water. Only site-related (hazardous) substances should be considered in determining the need for remedial action under the Comprehensive Environmental Response and Compensation Liability Act ("CERCLA"), or Superfund law. The following is a summary of ENVIRON's findings regarding these 36 substances:

Carcinogens

- Twenty-one of the 27 carcinogenic substances of potential concern were not detected in any of the 19 well water samples obtained by USACE in September 1995. These non-detected carcinogenic substances include: seven VOCs (i.e., bromodichloromethane, chloroform, 1,1-dichloroethene, methylene chloride, styrene, tetrachloroethene, trichloroethene, and vinyl chloride); six SVOCs (i.e., 1,4-dichlorobenzene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, and indeno[1,2,3cd]pyrene); and eight pesticides (i.e., aldrin, α -chlordane, δ -chlordane, β -benzenehexachloride (β -BHC), 4,4-DDE, 4,4-DDT, dieldrin, and heptachlor). These non-detections in ground water during September 1995 indicate that the 21 carcinogenic substances are not site-related chemicals of concern in ground water. This conclusion is also supported by the ground water sampling results from the RI for these substances.
- Two of the twenty-seven carcinogenic substances of potential concern (i.e., arsenic and beryllium) were detected in well water samples from upgradient (background) and downgradient wells in September 1995. Considering the results of both the RI and the September 1995 sampling events, arsenic and beryllium were found not to be elevated in downgradient wells relative to upgradient wells, according to the results of the Wilcoxon test (which is a non-parametric statistical test recommended by Agency guidance documents for situations where the frequency of detection is low).
- Four of the twenty-seven carcinogenic substances of potential concern (i.e., bis(2-ethylhexyl)phthalate, trichloroethylene, benzene and carbazole) were detected in September 1995 in well water samples only from downgradient wells.
 - Two of these four substances (i.e., bis(2-ethylhexyl)phthalate and trichloroethylene) were detected in upgradient monitoring wells during the RI, however, at concentrations greater than those reported in downgradient well samples in

September 1995. For bis(2-ethylhexylphthalate), the frequency of detection during the RI was similar in upgradient and downgradient wells (i.e., approximately 25% to 33%). Trichloroethylene was detected in only one (i.e., less than 5%) of the 30 downgradient samples collected during the two events; the sole detection was at a concentration (0.9 $\mu\text{g/L}$) less than the Maximum Contaminant Level (MCL) under the federal Safe Drinking Water Act (5 $\mu\text{g/L}$). Given these results, the RI and the September 1995 data provide no basis for concluding that bis(2-ethylhexyl) phthalate or trichloroethylene are site-related chemicals of concern in ground water.

- Carbazole was detected in only one of the 19 split ground water samples collected in September 1995. The reported detection was in the sample from new shallow well WT116A, which may not reflect authentic ground water contamination (for reasons documented in Section III and Appendix B of this report). It was not detected in any of the 29 ground water samples collected during the RI. The low frequency of detection (i.e., less than 5%), including no detections in the "on landfill" wells, indicates that carbazole is not a site-related chemical of concern in ground water.
- Benzene was detected in three of the 19 split ground water samples collected in September 1995. The maximum detected concentration was reported in a sample from new shallow well WT116A, which may not reflect authentic ground water contamination (for reasons documented in Section III and Appendix B of this report). With the exception of the sampling results for well WT116A, the detects of benzene during the RI and in September 1995 were at concentrations (range of 1 to 3 $\mu\text{g/L}$) less than the federal MCL (5 $\mu\text{g/L}$). Considering the results of both the RI and the September 1995 sampling events, including the questioned sampling result for well WT116A in September 1995, benzene was found not to be elevated in downgradient wells relative to upgradient wells, according to the results of the Wilcoxon test.

Non-carcinogens

- One of the nine non-carcinogenic substances of potential concern (chlorobenzene) was not detected in any of the 19 well water samples obtained by USACE in September 1995. Chlorobenzene was detected in only one of the 29 samples collected during the RI at a

concentration of 0.9 µg/L; it was not detected in any leachate or soil samples during the RI. Given the low frequency of detection (i.e., less than 5%) and the absence of chlorobenzene in leachate or soil samples, the RI and September 1995 data provide no basis for concluding that chlorobenzene is a site-related chemical of concern in ground water.

- Five of the nine non-carcinogenic chemicals of potential concern (i.e., antimony, barium, chromium, silver, vanadium) were detected in both upgradient (background) and downgradient wells in September 1995 and during the RI.
 - For antimony, chromium, silver, and vanadium, the maximum detected concentration in September 1995 was from an upgradient (background) well sample. Given these results, the RI and September 1995 data provide no basis for concluding that antimony, chromium, silver, or vanadium is a site-related chemical of concern in ground water.
 - Barium was detected in all 48 well water samples obtained from 31 monitoring wells on or near the Site during the RI (1990-91) and the September 1995 split sampling event. Considering the results of both the RI and the September 1995 sampling events, barium was found to be elevated in on-site, downgradient wells south of the landfill (but not elevated in the "on landfill" wells that are closer to the landfilled mass), relative to upgradient wells, according to the results of the t-test (which is a parametric statistical test recommended by Agency guidance documents for comparing a group of downgradient well data to a group of upgradient well data).
- Two of the nine non-carcinogenic substances of potential concern (carbon disulfide and cadmium) were detected in September 1995 in well water samples only from downgradient monitoring wells. Considering the results of both the RI and the September 1995 sampling events, carbon disulfide and cadmium were found not to be elevated in downgradient wells relative to upgradient wells, according to the results of the Wilcoxon test.

In September 1993, the USEPA issued its Record of Decision ("ROD") which presented the Agency's preferred remedial action for the Site. The ROD was based upon a baseline risk assessment, which was conducted by LSI using RI data and which concluded that the landfill does not pose an unacceptable health risk for current land use and existing exposure scenarios. LSI also conducted a health risk assessment for hypothetical future land use and exposure scenarios, which assumed that individuals consumed on-site leachate¹ and ground water for a substantial portion of a lifetime; LSI concluded that the health risk measures under these assumed exposure conditions would be greater than the Agency's typically allowable levels.

According to the Agency's *Risk Assessment Guidance for Superfund*, an early step in the health risk assessment process is to identify site-related chemicals of potential concern based, in part, upon an evaluation of frequency of detection and the magnitude and spatial pattern of detected concentrations (USEPA 1989). LSI's risk assessment did not identify site-related chemicals of concern according to this approach. Instead, LSI identified as "site-related" practically all substances detected in any sample or medium, regardless of its source.²

ENVIRON has evaluated LSI's baseline risk assessment in the context of the September 1995 ground water monitoring data obtained by USACE and the findings summarized above. As a result of the evaluation of LSI's cancer risk assessment, ENVIRON has determined the following:

- Almost all (i.e., 99.9% or more) of the cumulative (all-chemical) LCR calculated by LSI for the "on landfill" and "south of landfill" exposure locations is associated with substances that were detected only in leachate or soil or were detected in upgradient (i.e., background) wells. The RI and September 1995 data provide no basis for concluding that these substances are site-related chemicals of concern in ground water.

¹ Because LSI assumed that hypothetical future residents on the landfilled mass will drink leachate (i.e., soil water within the landfilled mass above the regional ground water table), the LCR values obtained by LSI for the "on landfill" exposure scenario do not represent incremental risks related to the use of ground water.

² As summarized above, the RI and September 1995 data provide no basis for concluding that any of the 27 carcinogenic substances considered in LSI's baseline risk assessment is a site-related chemical of concern in ground water. Of the nine non-carcinogenic substances considered in LSI's baseline risk assessment, only barium was determined to possibly be a site-related substance in ground water.

- If the LCR values for substances detected in upgradient (background) wells or detected only in leachate or soil during the RI are not considered, then the cumulative LCR posed by future use of ground water by hypothetical on-site residents is due only to benzene and, according to LSI's calculations, is within the acceptable risk range (i.e., less than one per ten thousand (1×10^{-4}), as established by the National Contingency Plan ("NCP") for the "on landfill" and "south of landfill" exposure locations. Considering the results of both the RI and the September 1995 sampling events, even benzene was found not to be elevated in downgradient wells relative to upgradient wells.

In summary, the cumulative LCR obtained by LSI do not represent incremental risks demonstrably related to the Site and past landfilling operations. The LCR values associated with detected, site-related substances do not warrant the remedial action recommended by the Agency in its ROD for the Site.

As a result of the evaluation of LSI's non-cancer risk assessment, ENVIRON has determined the following:

- All (100%) of the Hazard Index (HI; i.e., all-chemical sum of HQ values) calculated by LSI for the "south of landfill" exposure locations is associated with six substances that were detected in upgradient (background) wells during the RI.
- If the HQ values for substances detected in upgradient (background) wells and substances detected only in leachate are not considered, then the HI (cumulative HQ) posed by future use of ground water by hypothetical on-site residents is due only to cadmium and chlorobenzene. According to LSI's calculations, the HQ value is equal to or less than 0.1 for both substances for the "on landfill" and "south of landfill" exposure locations.³ Considering the results of both the RI and the September 1995 sampling events, cadmium and chlorobenzene were found not to be elevated in downgradient wells relative to upgradient wells.

³ A HQ value less than 1 is considered safe for the general population. Because of the conservative manner by which non-cancer Reference Doses (RfDs) are derived, a HQ value greater than 1 does not necessarily indicate that adverse health effects will occur, even if the assumed exposure conditions are realized.

- According to LSI's calculations, the HQ associated with barium, the only non-carcinogenic substance in ground water determined to be possibly site-related, is less than 0.1 for all exposure locations.

In summary, the HI (cumulative HQ) values obtained by LSI do not represent exposures demonstrably related to the Site and past landfilling operations. The HI (and HQ) values associated with detected site-related substances do not warrant the remedial action recommended by the Agency in its ROD for the Site.

II. INTRODUCTION

The Himco Landfill site ("the Site") is located at County Road 10 and the Nappanee Street Extension in Cleveland Township, adjacent to the City of Elkhart in Indiana. It was privately operated by Himco Waste Away Services, Inc. from 1960 until September 1976. The Site was proposed for the National Priorities List ("NPL") in June 1988 and was officially placed on the NPL by USEPA Region V in February 1990. In September 1993, the USEPA issued its ROD, which presented the Agency's preferred remedial action for the Site. The ROD called for institutional controls (that ban the construction and operation of drinking water wells on site) to mitigate any direct human exposures to shallow ground water underneath the site and ground water monitoring to provide a basis for assessing whether ground water quality conditions are changing in the vicinity of the Site. In addition, the ROD called for construction and maintenance of a multi-media cap over the entire landfill.

As part of remedial design activities, field personnel from the U.S. Army Corps of Engineers, Omaha District, ("USACE") conducted ground water monitoring at the Site in September 1995 as contractors to USEPA Region V. Samples were collected from seven existing monitoring wells and from twelve new monitoring wells. The seven existing ground water monitoring wells sampled during September 1995 were WTE1, WT01, WT101A, WT101B, WT102A, WT102B, and WT111A (see Figure 1 for well locations). Most of the new monitoring wells (i.e., wells WT112A, WT112B, WT114A, WT114B, WT115A, WT116A, WT116B, WT117A, WT117B, and WT118B) were placed in locations or at depths that had not been previously sampled during the RI. Four of the new wells (i.e., wells WT112A, WT112B, WT113A, and WT113B) were installed north (upgradient) of the landfill, six were installed south (downgradient) of the landfill (i.e., WT115A, WT116A, WT116B, WT117A, WT117B, and WT118B), and two were installed on the eastern edge of the landfill (i.e., WT114A, WT114B). Sampling these new and existing monitoring wells provided data regarding ground water quality around the perimeter of the landfill. Samples were analyzed for metals, cyanide, volatile organic compounds, semi-volatile compounds, pesticides, and polychlorinated biphenyls. The analytical data for these samples are shown, as received, in Appendix A of this report.

EIS Environmental Engineers, Inc. ("EIS") was present during the September 1995 sampling event to (1) observe and record USACE's field activities, and (2) obtain and analyze

split samples of ground water from the various wells sampled by USACE personnel. EIS prepared a report of its findings, which is included as Appendix B of this report.

ENVIRON Corporation has reviewed the analytical data obtained by USACE and EIS. This report summarizes ENVIRON's analysis and conclusions regarding the ground water sampling data. ENVIRON's report consists of six primary sections, as follows:

- Executive Summary (Section I), which summarizes the data, methods, and conclusions of ENVIRON's analysis of ground water quality conditions in the vicinity of the Site;
- Introduction (Section II), which provides useful background information regarding the preparation of this report;
- Ground Water Sampling Data (Section III), which summarizes the new ground water sampling data with particular emphasis on the USEPA sampling data and substances detected in one or more monitoring wells during the Remedial Investigation ("RI");
- Summary of Baseline Risk Assessment (Section IV), which summarizes and analyzes the baseline health risk assessment for the Site, which was conducted by Life Systems, Inc. "(LSI)", a contractor to USEPA Region V, and upon which the ROD is based;
- Implications of ENVIRON's Findings (Section V), which discusses ENVIRON's findings in the context of the National Contingency Plan and the need for any further remedial action at the Site; and
- References (Section VI), which provides documentation for publications cited and relied upon in this report.

III. ASSESSMENT OF GROUND WATER QUALITY

A. Overview

Based on the analytical results of ground water monitoring samples collected during the RI and during the September 1995 split sampling event, ENVIRON evaluated whether releases from the Site, if any, have adversely impacted local ground water. The analysis involved three steps, which included:

- Compiling all available ground water monitoring data collected at the Site by contractors to USEPA Region V;
- Identifying chemical substances that have been detected by contractors to USEPA Region V in one or more monitoring well(s) and that could contribute significantly to either cancer or noncancer risks under the ground water exposure conditions hypothesized by LSI; and
- Evaluating the potential sources of and impacts posed by these substances, based upon the spatial and temporal patterns of their detected concentrations in monitoring well samples.

The remainder of this chapter describes each of the steps listed above in greater detail and summarizes the results of ENVIRON's findings.

B. Ground Water Monitoring Data

The first step in the analysis was to compile all available ground water monitoring data collected at the Site. As part of the RI, twenty-nine samples were taken from 17 wells between November 1990 through September 1991. An additional 19 samples were collected by USACE in September 1995 from 19 monitoring wells, including 12 new wells. The monitoring wells sampled in the RI and in the September 1995 sampling event are shown in Figure 1.

As part of its baseline risk assessment, LSI divided the monitoring wells sampled during the RI into four groups: background wells, on the landfill wells, south of the landfill "shallow" wells, and south of the landfill "deep" wells (see Table 1). As a result, before

analyzing the split samples collected in September 1995, ENVIRON assigned each of the twelve new wells into one of the four groups developed by LSI (see Table 1), based upon their location and depth. New wells less than 50 feet deep were considered "shallow" wells, while new wells greater than 50 feet were considered "deep" wells.

ENVIRON also performed a quality assurance/quality control (QA/QC) of the analytical results provided by USEPA Region V in September 1995. A detailed description of this review and its results can be found in Appendix C. In summary, ENVIRON reviewed the materials enclosed in Appendix A of this report (i.e., the case narratives and associated laboratory reports and the supplemental information provided by USEPA for the September 1995 sampling event) and compared the laboratory performance and the analytical results to the quality control (QC) criteria outlined in *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* ("the Functional Guidelines"). ENVIRON then evaluated the data qualifiers assigned by the USEPA data reviewer to determine whether the qualifiers were appropriately applied as described in the Functional Guidelines. ENVIRON modified the qualifiers in instances where, in its judgement, the Functional Guidelines were not properly applied. ENVIRON also identified additional qualifications in instances where the available documentation provided a reasonable and appropriate basis for extending the quality assurance review beyond that reported by USEPA Region V.

Finally, ENVIRON compared the analytical results obtained by USEPA contractors with those obtained for split samples that were analyzed by EIS (as reported in Appendix B). The sample-by-sample comparison revealed no major differences between the two data sets for most samples and analytes.⁴ On this basis, the analytical results obtained by USEPA Region V were evaluated by ENVIRON for purposes of the remainder of this report. Selected (minor) discrepancies between the results for the split samples are identified and discussed later in this report.

C. Identification of Chemicals of Potential Concern

During the RI and the split sampling event in September 1995, ground water underneath the Site and in the vicinity of the Site was sampled and analyzed for over 100 different

⁴ For the convenience of the reader, the split sample results are compared by monitoring well and analyte group in the listings in Appendix D of this report.

chemicals. For purposes of this report, ENVIRON focussed its analysis on 27 substances regarded by USEPA to be carcinogens and nine non-carcinogenic substances that pose the greatest potential for any health risks associated with future residential use of ground water on the Site. This section describes how ENVIRON identified the 36 chemical substances that are the subject of Sections III.D and III.E of this report.

1. Carcinogenic Substances

Based upon the RI data, LSI found that 26 carcinogenic substances would pose LCR values greater than one per million (1×10^{-6}), the lower end of the acceptable risk range established by the NCP, under the exposure conditions assumed by LSI in the baseline health risk assessment.⁵ These 26 substances include:

- nine volatile organic compounds (VOCs) (i.e., benzene, bromodichloromethane, chloroform, 1,1-dichloroethene, methylene chloride, styrene, tetrachloroethene, trichloroethene, and vinyl chloride);
- seven semi-volatile organic compounds (SVOCs) (i.e., bis(2-ethylhexyl)phthalate, 1,4-dichlorobenzene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, and indeno[1,2,3cd]pyrene);
- eight pesticides (i.e., aldrin, α -chlordane, δ -chlordane, β -benzenehexachloride (β -BHC), 4,4-DDE, 4,4-DDT, dieldrin, and heptachlor); and
- two metals (i.e., arsenic and beryllium)

ENVIRON conducted two tasks to identify additional substances of potential concern, beyond the 26 substances identified on the basis of LSI's assessment, as follows:

- Identifying chemicals that were not previously evaluated by LSI due to lack of appropriate toxicity values (oral slope factors) from USEPA sources; and

⁵ A summary of LSI's assessment is presented in Appendix E of this report.

- Identifying chemicals that could pose excess lifetime cancer risks greater than one per ten million (1×10^{-7}) based upon the maximum detected concentration in any well water sample from either the RI or the September 1995 sampling event and under the exposure conditions assumed by LSI in the baseline risk assessment.

The USEPA's Integrated Risk Information System (IRIS) and the latest quarterly Health Effects Summary Tables (HEAST) were reviewed to determine whether any substances identified as carcinogenic chemicals of concern by LSI, but not evaluated in the baseline health risk assessment (presumably) due to lack of appropriate toxicity values, have since had cancer slope factors derived and published by the USEPA. On this basis, α -benzenehexachloride (α -BHC), carbazole, and 1,2-dichloropropane were identified as candidates for further evaluation.

A risk screening test was used to identify chemicals that could potentially pose excess lifetime cancer risks greater than one per ten million (1×10^{-7}) based on their sample concentrations as reported by USEPA. ENVIRON calculated LCR values using the same exposure assumptions and exposure parameters that LSI used in the baseline risk assessment. For purposes of this risk screening only, exposure concentrations for detected chemicals were conservatively assumed to be equal to the maximum detected concentration of the substance for any well sample during either the RI or the September 1995 split sampling event. For purposes of this risk screening only, exposure concentrations for non-detected substances were conservatively assumed to be equal to the highest SQL for the substance for any sample during either the RI or the September 1995 split sampling event. This conservative risk screening test identified only carbazole, an SVOC, as a chemical of potential concern, in addition to the 26 substances listed above.

2. Noncarcinogenic Substances

Noncarcinogenic substances of potential concern were identified using a similar process as described above for carcinogens. Based upon the RI data, LSI found that six substances would pose HQ values greater than 1 under the exposure conditions assumed in the baseline risk assessment (see Appendix E); these substances include:

- one VOC (i.e., carbon disulfide);

- four metals (i.e., antimony, cadmium, chromium, and vanadium); and
- nitrate/nitrite.

ENVIRON conducted two tasks to identify additional substances, beyond the 6 substances identified on the basis of LSI's assessment, as follows:

- Identifying chemicals that were not previously evaluated by LSI due to lack of appropriate toxicity values (oral Reference Doses) from USEPA sources; and
- Identifying chemicals that could pose a HQ greater than 0.1 based upon the maximum detected concentration in any well water sample from either the RI or the September 1995 sampling event and under the exposure conditions assumed by LSI in the baseline risk assessment.

The USEPA's Integrated Risk Information System (IRIS) and the latest quarterly Health Effects Summary Tables (HEAST) were reviewed to determine whether any substances identified as non-carcinogenic chemicals of concern by LSI, but not evaluated in the baseline health risk assessment (presumably) due to lack of appropriate toxicity values, have since had oral Reference Doses (RfDs) derived and published by the USEPA. On this basis, no additional substances were identified as candidates for further evaluation.

A risk screening test was used to identify chemicals that could potentially pose a HQ value greater than 0.1 (which is well below any level of health concern), based upon the sample concentrations reported by USEPA. HQ values were calculated by ENVIRON using the same exposure assumptions and exposure parameters that LSI used in the baseline risk assessment. For purposes of the risk screening only, exposure concentrations for detected chemicals were conservatively assumed to be equal to the maximum detected concentration of the substance in any well sample during either the RI or the September 1995 split sampling event. For purposes of the risk screening only, exposure concentrations for nondetected chemicals were conservatively assumed to be equal to the highest SQL for the substance for any water sample collected during either the RI or the September 1995 split sampling event. This conservative risk screening test

identified three additional non-carcinogenic chemicals of potential concern: one VOC (chlorobenzene) and two metals (barium and silver).

D. Analysis of Carcinogenic Chemicals of Potential Concern

This section summarizes and discusses the analytical results of the September 1995 well water samples, as obtained by the USACE for USEPA Region V, for the 27 carcinogenic substances identified as chemicals of potential concern, on the basis of the criteria established above. These analytical data are evaluated in the context of the RI sampling results.⁶ Emphasis is placed upon substances that were actually detected in monitoring well samples during either ground water sampling event, as distinct from substances that were detected only in soil or leachate samples during the RI. For the carcinogens that were detected in one or more well samples, ENVIRON tabulated the frequency of detection and range of detected concentrations in the two ground water sampling events (totalling 48 well water samples). ENVIRON evaluated the frequency of detection and the magnitude and spatial pattern of detected concentrations for each of these substances to identify which ones may be related to past landfilling operations at the Site. Only substances that were detected in downgradient wells at a frequency of detection of 10% or greater (once or more every 10 samples) and at elevated concentrations, relative to upgradient (background) ground water samples, were judged to be site-related chemicals of potential concern in ground water. Only site-related (hazardous) substances should be considered in determining the need for remedial action under CERCLA.

1. Substances Not Detected in Any Monitoring Well Sample

Twenty-one of the 27 carcinogenic substances of potential concern were not detected in any of the 19 well water samples obtained by USACE in September 1995. These non-detected carcinogenic substances include:

- seven of the nine VOCs (i.e., bromodichloromethane, chloroform, 1,1-dichloroethene, methylene chloride, styrene, tetrachloroethene,

⁶ Section IV of this report evaluates the analytical data in the context of LSI's baseline health risk assessment for ground water.

trichloroethene, and vinyl chloride⁷);

- six of the eight SVOCs (i.e., 1,4-dichlorobenzene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, and indeno[1,2,3cd]pyrene); and
- all eight pesticides (i.e., aldrin, α -chlordane, δ -chlordane, β -benzenehexachloride (β -BHC), 4,4-DDE, 4,4-DDT, dieldrin, and heptachlor).

These non-detections in ground water during September 1995 indicate that the 21 carcinogenic substances are not site-related chemicals of concern in ground water. This conclusion is supported by the ground water sampling results from the RI, as follows:

- Substances Detected Only In Leachate or Soil During the RI

Eighteen of these 21 carcinogenic substances were not detected in any of the 29 water samples collected from 17 monitoring wells during the RI. Fifteen of the 18 were considered chemicals of concern in ground water by LSI solely due to

⁷ With the exception of vinyl chloride, none of these substances was detected in any of the split samples, according to EIS' analytical results. Vinyl chloride was detected in one sample from a shallow well (WT116A) and one sample from a deep well (WT118B) downgradient of the landfill, but was not detected in any of the other 17 well water samples collected in September 1995 (see Appendix D), according to EIS' analytical results. Again, EPA's results showed no detections of vinyl chloride for any of the 19 samples collected in September 1995. The cumulative frequency of detection in downgradient wells for the RI and September 1995 sampling events (total of 30 samples) is 0% using EPA analyses and 6% according to EIS' analyses. Vinyl chloride was not detected in any ground water samples from the "on landfill" wells that are closest to the landfilled mass. In addition, vinyl chloride can arise as a result of the biodegradation of trichloroethylene, which was detected in an upgradient (background) well during the RI. Given the above, the RI and September 1995 data provide no basis for concluding that vinyl chloride is a site-related chemical of concern in ground water.

their detection in one or more samples of leachate.⁸ Three of the 18 were considered chemicals of concern in ground water by LSI solely due to their detection in one or more samples of soil.⁹ Because these 18 substances were not detected in ground water during either the RI or the September 1995 split sampling event (total of 48 well water samples), there is no evidence that they have been released from leachate or soil, respectively, into ground water. As a result, there is no basis to conclude that these 18 substances are site-related chemicals of concern present in ground water.

- Substances Detected Only In Upgradient (Background) Wells During the RI
One of the 21 carcinogenic substances, bromodichloromethane, was detected solely in background samples during the RI (see Table 4). It was not detected in any of the 17 samples collected during the RI from on-site monitoring wells downgradient or sidegradient of the landfill mass. Based on the RI and September 1995 ground water sampling data, there is no basis to conclude that bromodichloromethane is a site-related chemical of concern in ground water.
- Substances Detected In Upgradient and Downgradient Wells During the RI
Two of the 21 carcinogenic substances (i.e., chloroform and methylene chloride) are VOCs that were detected in upgradient and downgradient monitoring wells during the RI. Both are also common laboratory contaminants.

During the RI, chloroform was detected in three of 12 (or 25% of the) upgradient (background) well samples and in one sample from each group of downgradient monitoring wells (on the landfill, south of the landfill shallow, and south of the

⁸ Residents hypothesized to live on the landfill were assumed by LSI to consume leachate (i.e., unfiltered water from within the waste mass, but well above the regional ground water table) (see Appendix E). The substances detected only in leachate samples during the RI included three VOCs (i.e., styrene, tetrachloroethene, and vinyl chloride), five SVOCs (benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, and indeno[1,2,3cd]pyrene), and seven pesticides (4,4-DDT, aldrin, alpha-chlordane, beta-BHC, dieldrin, gamma-chlordane, and heptachlor).

⁹ The substances detected only in soil samples during the RI included one VOC (1,1-dichloroethene), one SVOC (1,4-dichlorobenzene), and one pesticide (4,4-DDE).

landfill deep); hence, the frequency of chloroform detection in the downgradient wells (3 out of 17 samples or 18%) was equal to or less than that for the upgradient wells (see Table 3). Each of the three detections in background (upgradient) well water samples (range of 4 to 26 $\mu\text{g/L}$) was greater than any of the three downgradient detections (range of 1 to 2 $\mu\text{g/L}$). Given the above, neither the RI or September 1995 data provide any basis for concluding that chloroform is a site-related chemical of concern in ground water.

During the RI, methylene chloride was detected in two of 12 upgradient (background) well samples and in one sample each from the landfill well group and the south of the landfill shallow well group (i.e., two out of 17 total downgradient samples; see Table 4). It was not detected in any samples taken from the south of the landfill deep well group. The maximum detected concentration in any monitoring well (19 $\mu\text{g/L}$) was found in one of the background samples. Given the above, neither the RI or September 1995 data provide any basis for concluding that methylene chloride is a site-related chemical of concern in ground water.

2. Substances Detected in Upgradient Monitoring Well Samples

Two of the twenty-seven carcinogenic substances of potential concern (arsenic and beryllium) were detected in well water samples from upgradient (background) and downgradient wells in September 1995.

a) Arsenic

Arsenic was detected in four of the 19 split samples collected in September 1995: in one of six upgradient (background) wells, two of three "on landfill" wells, and in one of five shallow wells south of the landfill (see Table 5). During the RI, arsenic was detected in unfiltered water samples from background wells, "on landfill" wells, and shallow and deep monitoring wells south of the landfill (see Table 5). Because of the reported detection of arsenic in the "on landfill" and south of the landfill wells in the RI and in the split sampling event, ENVIRON conducted a statistical analysis of the existing USEPA ground water quality data to determine whether arsenic concentrations in downgradient monitoring wells are significantly elevated relative to background levels. Details

of the statistical analysis (using the Wilcoxon Rank Sum Test) are summarized in Appendix F. Considering the results of both the RI and the September 1995 sampling events, total arsenic was found not to be elevated in downgradient wells relative to background levels (using a confidence level, α , of 5%).

b) Beryllium

Beryllium was detected in two of six upgradient (background) wells and two of five deep wells south of the landfill in September 1995 (see Table 6). It was not detected in the three "on landfill" wells or the five shallow wells south of the landfill in September 1995. During the RI, beryllium was detected in two unfiltered well water samples from background wells and in two unfiltered well water samples from shallow monitoring wells south of landfill (see Table 10).¹⁰ It was not detected in water samples from the "on landfill" wells or the deep wells south of the landfill during the RI. Because the reported detections of beryllium in downgradient wells during the RI and the split sampling event are comparable to those from background wells and because beryllium was not detected in the "on landfill" monitoring wells (see Table 10), the presence of beryllium in ground water during the RI may not be site-related. ENVIRON conducted a statistical analysis of the existing USEPA ground water quality data to determine whether beryllium concentrations in downgradient monitoring wells are significantly elevated relative to background levels. Details of the statistical analysis (using the Wilcoxon Rank Sum Test) are summarized in Appendix F. Considering the results of both the RI and the September 1995 sampling events, total beryllium was found not to be elevated in downgradient wells relative to background levels (using a confidence level, α , of 5%).

3. Substances Detected in Downgradient Monitoring Well Samples

Four of the twenty-seven carcinogenic substances of potential concern (bis(2-ethylhexyl)phthalate, trichloroethylene, benzene and carbazole) were detected in well

¹⁰ In Table A4-9 (Volume 5, SEC Donohue, 1992) LSI reported that beryllium was detected in two out of seven samples taken of deep groundwater. Based on ENVIRON's review of the analytical results found in Table B-3 (Volume 4 SEC Donohue, 1992), it appears that beryllium was not detected in any of six samples taken of deep groundwater.

water samples only from downgradient wells in September 1995. Two of these four substances (i.e., bis(2-ethylhexyl)phthalate and trichloroethylene) were detected in upgradient monitoring wells during the RI, as detailed below.

a. Bis(2-ethylhexyl) phthalate

During the RI, bis(2-ethylhexyl)phthalate was detected in approximately 25% to 33% of the well water samples in each group of monitoring wells: background, on the landfill, south of the landfill shallow, and south of the landfill deep (see Table 7). USEPA contractors reported detections of bis(2-ethylhexyl)phthalate in the September 1995 split samples from the "on landfill" wells and the downgradient wells, but not upgradient samples (see Table 7). The maximum detected concentration in September 1995 (15 $\mu\text{g/L}$) was for sample EARQ1 of shallow ground water south of the landfill (WT116A).¹¹ Because the duplicate of sample EARQ1 (i.e., sample EARQ0) was reported to be non-detect with a sample quantitation limit of 10 $\mu\text{g/L}$, the authenticity of the reported detection is called into question. Finally, the maximum detected concentration reported by USEPA contractors for the September 1995 split samples (15 $\mu\text{g/L}$) is lower than the maximum detection in upgradient (background) samples during the RI (32 $\mu\text{g/L}$; see Table 7). Given the above, neither the RI or September 1995 data provide any basis for concluding that bis(2-ethylhexyl)phthalate is a site-related chemical of concern in ground water.

b. Trichloroethene

During the RI, trichloroethene was detected in one upgradient (background) well sample (see Table 8). Trichloroethene was detected in only one of the 19 split well water samples collected in September 1995, in a downgradient well sample (well WT116A) at a concentration (0.9 $\mu\text{g/L}$) lower than the reported

¹¹ EIS reported (see Appendix B of this report) that USACE field personnel, while monitoring with a photoionization detector (PID), obtained elevated background readings at this well location, possibly due exhaust from a generator in the vicinity of the well. These observations suggest that the sample result may not represent actual ground water contamination.

detection during the RI in an upgradient well (2 $\mu\text{g/L}$; see Table 8).¹² Sample quantitation limits for the background wells during the split sampling event (10 $\mu\text{g/L}$) were not sufficiently sensitive to ensure that trichloroethene was not present in upgradient ground water at concentrations comparable to those detected in shallow well south of the landfill. Given the above, neither the RI or September 1995 data provide any basis for concluding that trichloroethene is a site-related chemical in ground water.

c. Carbazole

Carbazole was not detected in any of the 29 samples collected during the RI (Table 9). Carbazole was detected in only one of the 19 well water samples collected in September 1995 (see Table 9). It was detected at a concentration of 6 $\mu\text{g/L}$ in the sample taken from Well WT116A in the south of the landfill shallow well group. EIS reported (see Appendix B of this report) that USACE field personnel, while monitoring with a photoionization detector (PID), obtained elevated background readings at this well location, possibly due exhaust from a generator in the vicinity of the well. These observations suggest that the duplicate sample results for well WT116A may not represent actual ground water contamination. Given the low overall frequency of detection (i.e., less than 5%) and the failure to detect carbazole in any of the samples from the "on landfill" wells that are closest to the landfilled mass, there is no basis to conclude that carbazole is a site-related chemical of concern in ground water.

d. Benzene

During the RI and the September 1995 sampling events, benzene was detected in downgradient monitoring wells, but not in upgradient (background) wells. During the RI, it was detected once in the on landfill well group and twice in the south of the landfill shallow well group (see Table 10) out of 17 total downgradient well samples. The maximum detected concentration (3 $\mu\text{g/L}$) during the RI occurred in a sample taken from the south of the landfill shallow

¹² Both detected concentrations of trichloroethylene are less than the federal MCL for this substance (5 $\mu\text{g/L}$).

well group. All three detections during the RI were less than the federal MCL (5 $\mu\text{g/L}$).

Benzene was detected in three of the 19 split well water samples collected in September 1995 (see Table 10). It was detected once in the on landfill well group and twice in the south of the landfill shallow well group. The maximum concentration (15 $\mu\text{g/L}$) occurred in a sample taken from Well WT116A in the south of the landfill shallow well group. EIS reported (see Appendix B of this report) that USACE field personnel, while monitoring with a photoionization detector (PID), obtained elevated background readings at this well location, possibly due exhaust from a generator in the vicinity of the well. These observations suggest that the duplicate sample results at this well may not represent actual ground water contamination. The other two detections (at concentrations of 1 and 2 $\mu\text{g/L}$) were less than the federal MCL.

Sample quantitation limits for the background wells were 5 to 10 $\mu\text{g/L}$ during the RI and were 10 $\mu\text{g/L}$ for the September 1995 sampling event. These SQLs were not sufficiently sensitive to ensure that benzene was not present in upgradient ground water at levels that were comparable to those detected in shallow wells south of the landfill (range of 1 to 3 $\mu\text{g/L}$, if the questioned sampling result for well WT116A in September 1995 is neglected). ENVIRON conducted a statistical analysis of the existing ground water quality data to determine whether benzene concentrations in downgradient monitoring wells are significantly elevated relative to background levels. Details of the statistical analysis (using the Wilcoxon Rank Sum Test) are summarized in Appendix F. Considering the results of both the RI and the September 1995 sampling events, including the questioned sampling result for well WT116A, benzene was found not to be elevated in downgradient wells relative to background levels (using a confidence level, α , of 5%).

E. Analysis of Noncarcinogenic Chemicals of Potential Concern

This section summarizes and discusses the analytical results of the September 1995 well water samples, as obtained by the USACE for USEPA Region V, for the nine non-carcinogenic substances identified as chemicals of potential concern, on the basis of the criteria established above. The analytical data are evaluated in the context of the RI sampling results. Emphasis is placed upon non-carcinogenic substances that were actually detected in monitoring

well samples during either sampling event, as distinct from substances that were detected only in soil or leachate samples during the RI. For the non-carcinogens that were detected in one or more well samples, ENVIRON tabulated the frequency of detection and range of detected concentrations in the two ground water sampling events (total of 48 well water samples). ENVIRON evaluated the frequency of detection and the magnitude and spatial pattern of detected concentrations for each of these substances to identify which ones may be related to past landfilling operations at the Site. Only substances that were detected in downgradient wells at a frequency of detection of 10% or greater (once or more every 10 samples) and at elevated concentrations, relative to upgradient (background) ground water samples, were judged to be site-related chemicals of potential concern in ground water. Only site-related (hazardous) substances should be considered in determining the need for remedial action under CERCLA.

1. Substances Not Detected in Any Monitoring Well Sample

One of the nine non-carcinogenic substances of potential concern (chlorobenzene) was not detected in any of the 19 well water samples obtained by USACE in September 1995. The non-detections in ground water during September 1995 indicate that chlorobenzene is not a site-related chemical of concern in ground water.

Chlorobenzene was detected in only one of the 29 samples collected during the RI at a concentration of 0.9 $\mu\text{g/L}$ in one sample from an "on landfill" well (see Table 11); it was not detected in any leachate or soil samples during the RI. Given the low frequency of detection (i.e., less than 5%) and the absence of chlorobenzene in leachate or soil samples, the RI and September 1995 data provide no basis for concluding that chlorobenzene is a site-related chemical of concern in ground water.

2. Substances Detected in Upgradient Monitoring Well Samples

Five of the nine non-carcinogenic chemicals of potential concern (i.e., antimony, barium, chromium, silver, vanadium) were detected in both upgradient (background) and downgradient wells in September 1995.

a. Antimony

During the RI, antimony was detected twice in upgradient (background) samples, once in the south of the landfill shallow well group, and twice in the south of the landfill deep well group (see Table 12). The maximum detected

concentration (48.7 $\mu\text{g/L}$) was found in a background sample. Antimony was not detected in the "on landfill" wells.

The USEPA's analytical results for the September 1995 sampling event were generally consistent with the RI results. Antimony was detected in two upgradient (background) monitoring wells and in one well in the south of the landfill shallow well group (see Table 12), but not in the "on landfill" wells. The maximum detected concentration (29.7 $\mu\text{g/L}$) was found in a background sample. Within a well grouping, the maximum reported antimony concentration tended to be lower in September 1995 than from the RI.

During both the RI and the September 1995 sampling event, the maximum detected concentration of antimony occurred in an upgradient (background) well sample. In addition, antimony was not detected in any of the ground water samples from the "on landfill" wells that are closest to the landfilled mass. Given the above, the RI and September 1995 data provide no basis for concluding that antimony is a site-related chemical of concern in ground water.

b. Barium

Barium was detected in all 48 well water samples obtained from 31 monitoring wells on or near the Site during the RI (1990-91) and the September 1995 split sampling event (see Table 13). The ubiquity of barium in both upgradient and downgradient monitoring wells indicates that barium is naturally occurring in ground water. Because the maximum detected concentration of barium during the RI and in September 1995 was from a downgradient well sample, ENVIRON conducted a statistical analysis of the existing ground water quality data to determine whether barium concentrations in downgradient monitoring wells are significantly elevated relative to background levels. Details of the statistical analysis (using the t-test, a parametric statistical test recommended by Agency guidance documents) are summarized in Appendix F. Considering the results of both the RI and the September 1995 sampling events, barium is not elevated in the "on landfill" wells that are closest to the landfilled mass, but is elevated in the on-site, downgradient wells south of the landfill, relative to background levels (using a confidence level, α , of 5%).

c. Chromium

During the RI, chromium was detected in four background samples, in one sample from the on landfill well group, in four samples from the south of the landfill shallow well group, and in two samples from the south of the landfill deep well group (Table 14). The USEPA's analytical results for the September 1995 sampling event report chromium being detected in two background samples, in two samples from the "south of the landfill shallow" well group, and in two samples from the "south of the landfill deep" well group, but not detected in the "on landfill" wells that are closest to the landfilled mass (see Table 14). The September 1995 data show the maximum detected concentration of chromium ($23.9 \mu\text{g/L}$) to be from an upgradient (background) well sample. Based upon the occurrence of chromium in both upgradient and downgradient monitoring wells at similar detected concentrations, there is no basis to conclude that chromium is a site-related chemical of concern in ground water.

d. Silver

During the RI, silver was detected in two background samples, in three samples from the on landfill well group, in one sample from the south of the landfill shallow well group, and in two samples from the south of the landfill deep well group (Table 15). The USEPA's analytical results for the September 1995 sampling event report silver being detected in two background samples and in two samples from the "south of the landfill deep" well group, but not detected in any ground water samples from the "on landfill" wells that are closest to the landfilled mass (see Table 15). The September 1995 data show the maximum detected concentration of silver ($19.5 \mu\text{g/L}$) to be from an upgradient (background) well sample. Based upon the occurrence of silver in both upgradient and downgradient monitoring wells at similar detected concentrations, the RI and September 1995 data provide no basis for concluding that silver is a site-related chemical of concern in ground water.

e. Vanadium

During the RI, vanadium was detected in three background samples, in three samples from the "on landfill" well group, in five samples from the south of the landfill shallow well group, and in four samples from the south of the

landfill deep well group (Table 16). The USEPA's analytical results for the September 1995 sampling event report vanadium being detected in four background samples, in three samples taken from the on landfill well group, in three samples from the south landfill shallow well group, and in two samples from the south of the landfill deep well group (see Table 16). The September 1995 data show the maximum detected concentration of vanadium ($26.5 \mu\text{g/L}$) to be from an upgradient (background) well sample. Based upon the occurrence of vanadium in both upgradient and downgradient monitoring wells at similar detected concentrations, the RI and September 1995 data provide no basis for concluding that vanadium is a site-related chemical of concern in ground water.

3. Substances Detected in Downgradient Monitoring Wells

Two of the nine non-carcinogenic substances of potential concern (carbon disulfide and cadmium) were detected in September 1995 in well water samples only from downgradient monitoring wells.

a. Carbon Disulfide

Carbon disulfide was not detected in any of the 29 well water samples collected during the RI (see Table 17); it was detected only in some leachate samples during the RI and was judged by LSI to be a chemical of concern solely on that basis. USEPA's analytical results for the September 1995 sampling event report carbon disulfide being detected twice in the on landfill well group and once in the south of the landfill "deep" well group (Table 17). Sample quantitation limits for the background wells during the split sampling event ($10 \mu\text{g/L}$) were not sufficiently sensitive, however, to ensure that carbon disulfide was not present in upgradient ground water at levels that were comparable to those detected in downgradient wells (i.e., $\leq 2 \mu\text{g/L}$).

Because the maximum detected concentration of carbon disulfide in September 1995 was from a downgradient well sample, ENVIRON conducted a statistical analysis of the existing ground water quality data to determine whether carbon disulfide concentrations in downgradient monitoring wells are significantly elevated relative to background levels. Details of the statistical analysis (using the Wilcoxon Rank Sum Test) are summarized in Appendix F. Considering the results of both the RI and the September 1995 sampling events,

carbon disulfide is not elevated in downgradient wells relative to background levels (using a confidence level, α , of 5%). Hence, the RI and September 1995 data provide no basis for concluding that carbon disulfide is a site-related chemical of concern in ground water.

b. Cadmium

During the RI, cadmium was detected in one "shallow" well sample and one "deep" well sample from monitoring wells south of the landfill during the RI (see Table 18); cadmium was also detected in some leachate samples during the RI. The USEPA's analytical results for the September 1995 sampling event report cadmium being detected in one well sample from the "on landfill" group and one well sample in the south of the landfill "shallow" well group (see Table 18). Because the detected concentrations from the September 1995 sampling event are lower than those from the RI (see Table 19), the abundance of cadmium in downgradient ground water may be decreasing with time.

Because the maximum detected concentration of cadmium in September 1995 was from a downgradient well sample, ENVIRON conducted a statistical analysis of the existing ground water quality data to determine whether cadmium concentrations in downgradient monitoring wells are significantly elevated relative to background levels. Details of the statistical analysis (using the Wilcoxon Rank Sum Test) are summarized in Appendix F. Considering the results of both the RI and the September 1995 sampling events, cadmium is not elevated in downgradient wells relative to background levels (using a confidence level, α , of 5%). Hence, the RI and September 1995 data provide no basis for concluding that cadmium is a site-related chemical of concern in ground water.

4. Substances Not Analyzed in September 1995

One of the nine non-carcinogenic substances of potential concern (nitrite/nitrate) was not analyzed in the September 1995 samples. Nitrite/nitrate (as a single analyte) was detected twice in upgradient (background) samples, four times in the south of the landfill shallow well group, and once in the south of the landfill deep well group (see Table 19) during the RI.¹³ The two highest detected concentrations (6,900 µg/L and 5,500 µg/L) were found in background samples, which may be attributable to the use of fertilizer and possibly other sources unrelated to the landfill. Given the above, there is no basis for concluding that nitrite/nitrate is a site-related chemical of concern in ground water.

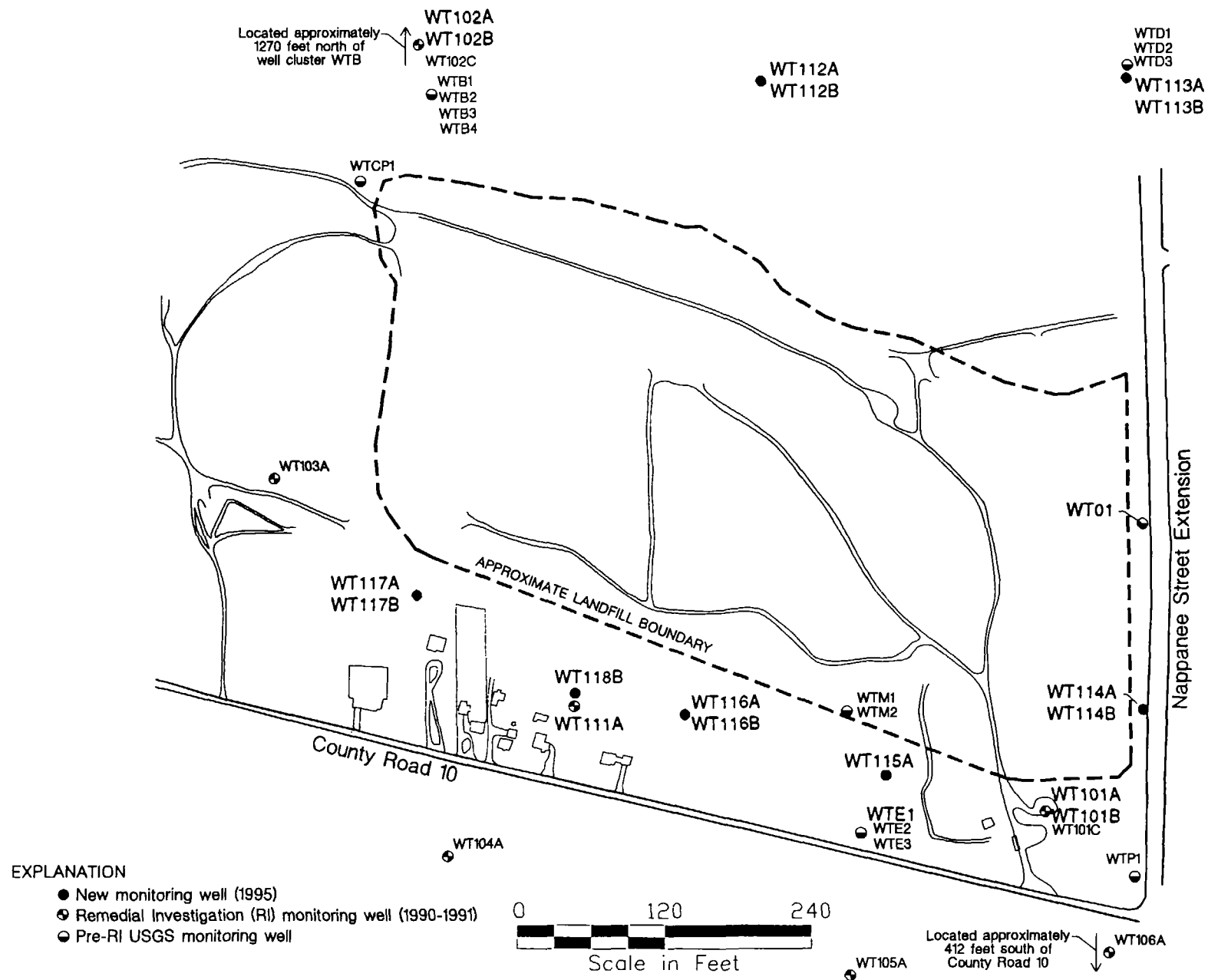
¹³ During the RI, leachate samples were also analyzed for nitrate/nitrite, but soil samples were not. The nitrite/nitrate analyses of leachate samples were judged unuseable by SEC Donohue, however.

IV. BASELINE HEALTH RISK ASSESSMENT

The ROD for the Site was based upon a baseline risk assessment, which was conducted by LSI and which concluded that the landfill does not pose an unacceptable health risk for current land use and existing exposure scenarios. LSI also conducted a health risk assessment for hypothetical future land use and exposure scenarios, which assumed that individuals consumed on-site leachate and ground water for a substantial portion of a lifetime; LSI concluded that the health risks under these assumed exposure conditions would be above the USEPA's acceptable risk range. USEPA Region V proposed a remedy for the Site to mitigate this hypothetical future on-site threat associated with residential development on the landfill mass. Additional information regarding LSI's assessment is provided in Appendix E.

According to the Agency's *Risk Assessment Guidance for Superfund*, an early step in the health risk assessment process is to identify site-related chemicals of potential concern based, in part, upon an evaluation of frequency of detection and the *magnitude and spatial pattern of detected concentrations* (USEPA 1989). In the case of ground water monitoring data, this step should include a rigorous comparison of the concentrations detected in upgradient versus downgradient wells (USEPA 1989, 1992). The intent of this screening is that only site-related (hazardous) substances should be considered in determining the need for remedial action under CERCLA. LSI's risk assessment did not identify site-related chemicals of concern according to this approach.¹⁴ Instead, LSI identified as "site related" practically all substances detected in any sample or medium. It also did not correct down-gradient exposure concentrations for any background contribution. Consequently, the values of lifetime cancer risk (LCR) and non-cancer Hazard Quotient (HQ) obtained by LSI do not represent incremental risks demonstrably related to the Site and past landfilling operations.

¹⁴ As summarized in Sections III.D and III.E of this report, the RI and September 1995 data provide no basis for concluding that any of the 27 carcinogenic substances considered in LSI's baseline risk assessment is a site-related chemical of concern in ground water. Of the nine non-carcinogenic substances considered in LSI's baseline risk assessment, only barium was determined to possibly be a site-related chemical of concern in ground water.



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LOCATION OF GROUNDWATER MONITORING WELLS
ON AND NEAR THE HIMCO NPL SITE IN INDIANA

Figure

1

LIFETIME CANCER RISKS (LCRs) FOR ON-SITE GROUND WATER USE

Impacts of LSI's Assumptions on LCRs for Four Exposure Locations

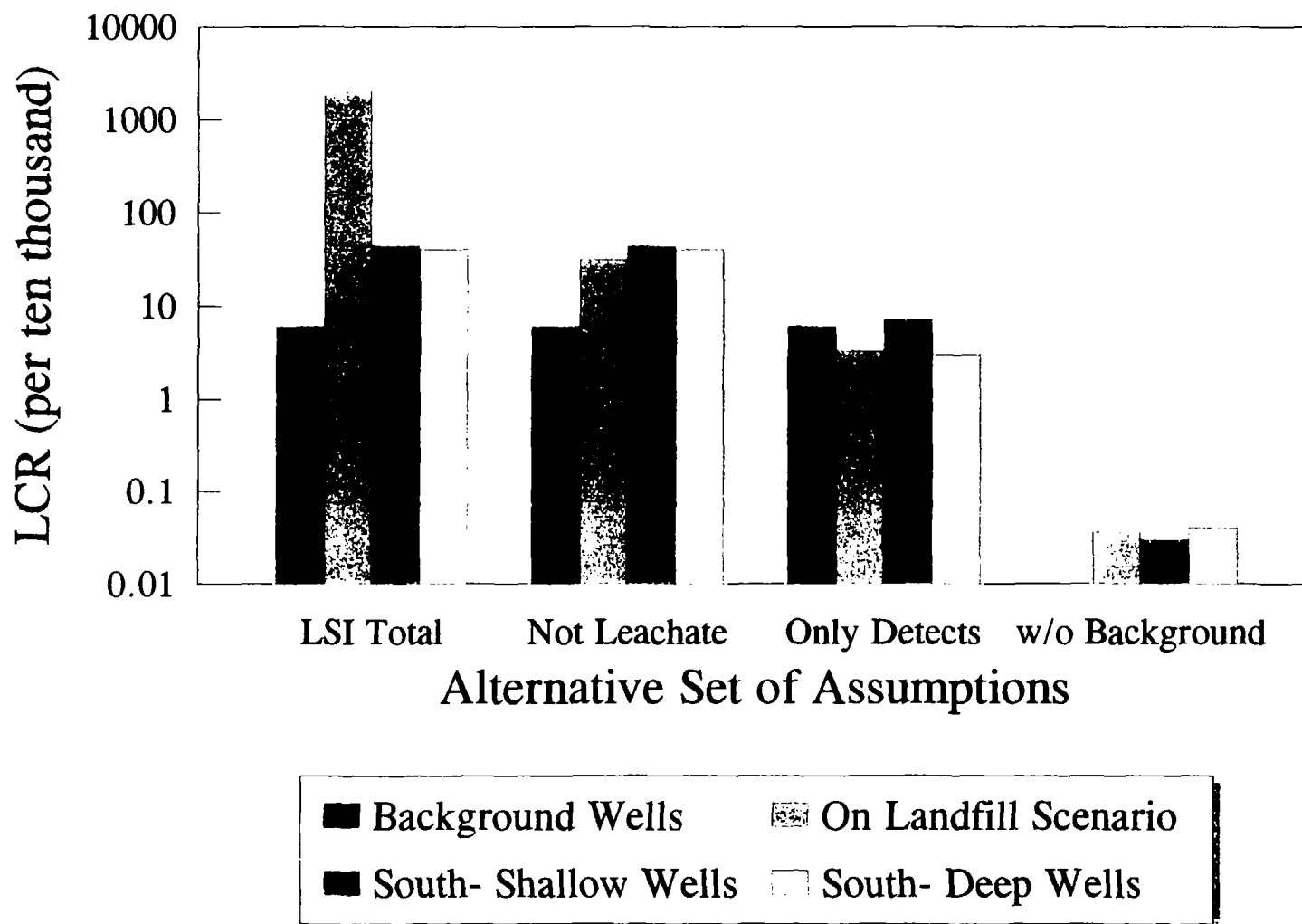


FIGURE 2

NON-CANCER HAZARD INDEX FOR ON-SITE GROUND WATER USE **Impacts of LSI's Assumptions on HIs for Four Exposure Locations**

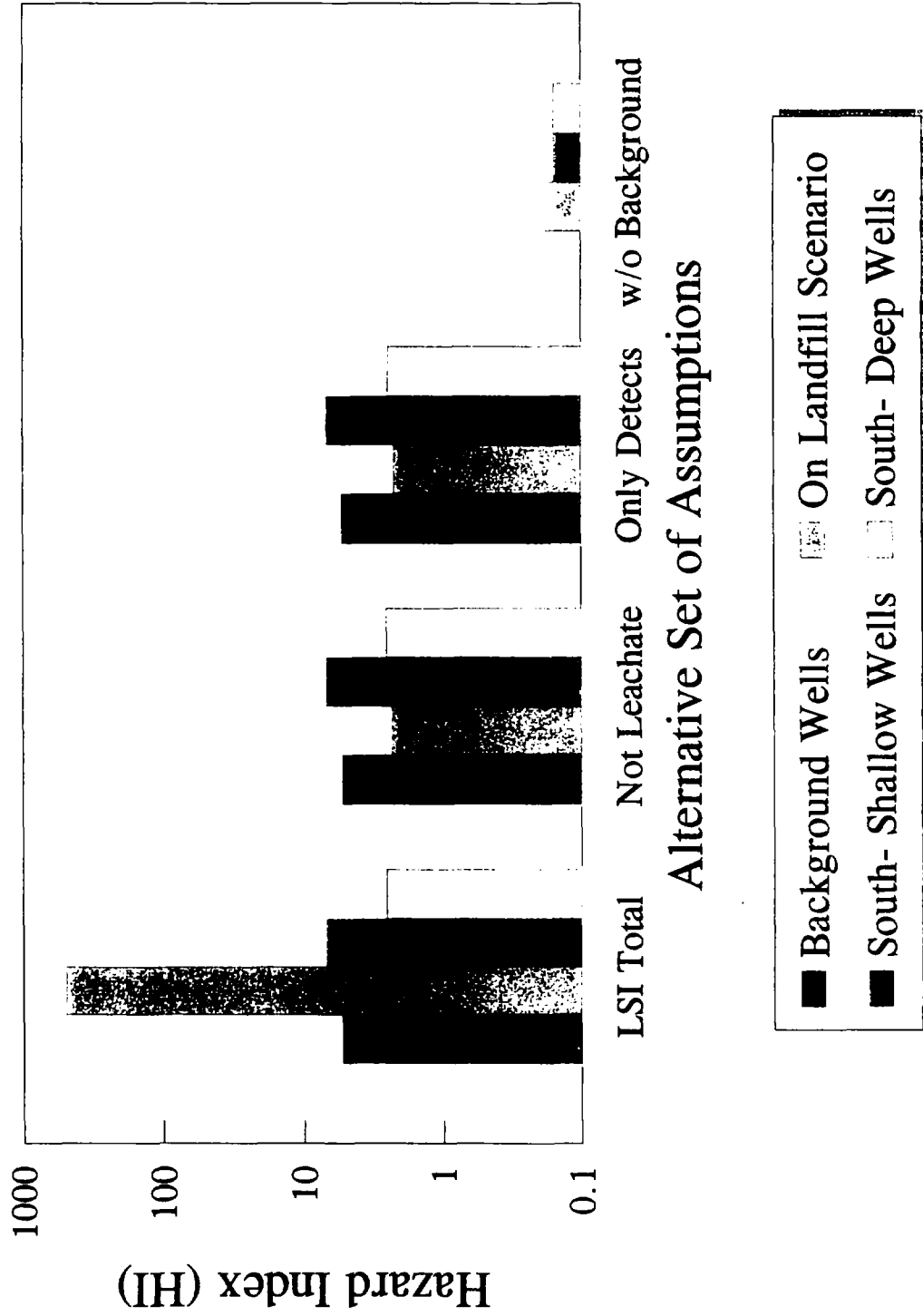


FIGURE 3

Tables

TABLE 1 Classification of Monitoring Wells on and Near the Himco Landfill				
Well Group	Monitoring Wells in Each Respective Well Group			
	Background	On Landfill	South Landfill (Shallow)	South Landfill (Deep)
Existing Remedial Investigation Well or USGS Well used in LSI's Risk Assessment	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT103A, WTCP1	WT101B, WT101C, WTE3, WTM1	WT101A, WT111A, WTE2, WTM2
Existing Remedial Investigation Well or USGS Well not used in LSI's Risk Assessment and Classified by ENVIRON	NA	WT01	WTE1	NA
New Monitoring Wells (1995) Classified by ENVIRON	WT112A, WT112B, WT113A, WT113B	WT114A, WT114B	WT116B, WT117B, WT118B	WT115A, WT116A, WT117A
Note: Figure 1 shows the locations of these wells. New wells less than 50 feet deep were considered "shallow" wells; new wells greater than 50 feet deep were considered "deep" wells.				

TABLE 2 Summary of Analytical Data for Bromodichloromethane in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	4	0	0	0	0	0	0	0
Range of Detected Concentrations (µg/L)	2 to 7	NA	NA	NA	NA	NA	NA	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-1 and B-19 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 3 Summary of Analytical Data for Chloroform in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	3	0	1	0	1	0	1	0
Range of Detected Concentrations (µg/L)	4 to 26	NA	1	NA	2	NA	2	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-1 and B-19 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 4 Summary of Analytical Data for Methylene Chloride in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	2	0	1	0	1	0	0	0
Range of Detected Concentrations (µg/L)	1 to 19	NA	2	NA	2	NA	NA	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-1 and B-19 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 5 Summary of Analytical Data for Total Arsenic in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	3	1	2	2	6	1	5	0
Range of Detected Concentrations (µg/L)	4.0 to 5.8	4.8	2.2 to 3.9	18.5 to 23.3	2.7 to 54.5	7.8	3.8 to 9.1	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	1 to 3	3.8	3	3.8	3.0	3.8	2.0	3.8
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-1, B-2, B-3, B-19, B-20, and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A4-8, A4-9, A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 6
Summary of Analytical Data for Total Beryllium in Groundwater Monitoring Wells, Himco Landfill¹

Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	2	2	0	0	2	0	0	2
Range of Detected Concentrations (µg/L)	1.2 to 3.1	0.5 to 1.3	NA	NA	1 to 5.4	NA	NA	0.92 to 1.1
Sample Quantitation Limits for Nondetect Samples (µg/L)	1.0 to 3.0	0.4	1 to 3	0.4	1.0 to 3.0	0.4	1.0 to 3.0	0.4

Notes:

NA: Not applicable

¹Data based on ENVIRON's review of the analytical results found in Tables B-1, B-2, B-3, B-19, B-20, and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A4-8, A4-9, A4-10 (Volume 5 SEC Donohue, 1992).

TABLE 7 Summary of Analytical Data for Bis(2-ethylhexyl)phthalate in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	4	0	1	1	2	4	2	1
Range of Detected Concentrations (µg/L)	3 to 32	NA	2	13	16 to 110	0.3 to 15	3	3
Sample Quantitation Limits for Nondetect Samples (µg/L)	10	10	10	10	10 to 11	10	10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-2 and B-20 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A4-8, A4-9, A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 8 Summary of Analytical Data for Trichloroethene in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	1	0	0	0	0	1	0	0
Range of Detected Concentrations (µg/L)	2	NA	NA	NA	NA	0.9	NA	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-1 and B-19 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 9 Summary of Analytical Data for Carbazole in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	6	6	1	3	4	5	4	5
Number of Detects	0	0	0	0	0	1	0	0
Range of Detected Concentrations (µg/L)	NA	NA	NA	NA	NA	6	NA	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	10	10	10	10	10	10	10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 10 Summary of Analytical Data for Benzene in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	0	0	1	1	2	2	0	0
Range of Detected Concentrations (µg/L)	NA	NA	0.9	2	1 to 3	1 to 15	NA	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-1, B-2, B-3, B-19, B-20, and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A4-8, A4-9, A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 11

Summary of Analytical Data for Chlorobenzene in Groundwater Monitoring Wells, Himco Landfill¹

Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	0	0	1	0	0	0	0	0
Range of Detected Concentrations (µg/L)	NA	NA	0.9	NA	NA	NA	NA	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10

Notes:

NA: Not applicable

¹Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).

TABLE 12 Summary of Analytical Data for Total Antimony in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	2	2	0	0	1	1	2	0
Range of Detected Concentrations (µg/L)	36 to 48.7	21.7 to 29.7	NA	NA	36.2	2.9	46.8 to 47.9	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	13 to 37	12.8	13 to 31	12.8	13 to 31	12.8	13	1.9 to 12.8
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 13 Summary of Analytical Data for Total Barium in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	12	6	4	3	7	5	6	5
Range of Detected Concentrations (µg/L)	22.5 to 124	14.3 to 92.5	27.6 to 79.6	74.3 to 237	49.4 to 250	50.1 to 136	75 to 222	35.8 to 347
Sample Quantitation Limits for Nondetect Samples (µg/L)	NA	NA	NA	NA	NA	NA	NA	NA
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 14 Summary of Analytical Data for Total Chromium in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	4	2	1	0	4	2	2	2
Range of Detected Concentrations (µg/L)	2.8 to 24.6	5.6 to 23.9	7.9	NA	2.2 to 133	4.2 to 7.1	2.8 to 7.7	14.4 to 20.6
Sample Quantitation Limits for Nondetect Samples (µg/L)	2 to 6	4	5 to 6	4	2 to 6	4	2 to 6	4
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 15 Summary of Analytical Data for Total Silver in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	2	2	3	0	1	0	2	2
Range of Detected Concentrations (µg/L)	7.7 to 9	4.9 to 19.5	6.9	NA	18.4	NA	11.2 to 11.6	10.9 to 18.2
Sample Quantitation Limits for Nondetect Samples (µg/L)	2 to 7	2.5	2 to 7	2.5	2 to 7.7	2.5	2	2.5
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

<p align="center">TABLE 16 Summary of Analytical Data for Total Vanadium in Groundwater Monitoring Wells, Himco Landfill¹</p>								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTC1P1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	3	4	3	3	5	3	4	2
Range of Detected Concentrations (µg/L)	8.5 to 26.8	9.6 to 26.5	5.2 to 12.5	6.9 to 23.2	4.5 to 106	10.1 to 20.9	3.0 to 12.1	17.8 to 18.8
Sample Quantitation Limits for Nondetect Samples (µg/L)	2.0 to 8.5	4.5	3	NA	3 to 12.2	4.5	2	4.5
<p>Notes: NA: Not applicable ¹Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).</p>								

TABLE 17

Summary of Analytical Data for Carbon Disulfide in Groundwater Monitoring Wells, Himco Landfill¹

Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	0	0	0	2	0	0	0	1
Range of Detected Concentrations (µg/L)	NA	NA	NA	0.7 to 2	NA	NA	NA	2
Sample Quantitation Limits for Nondetect Samples (µg/L)	5 to 10	10	5 to 10	10	5 to 10	10	5 to 10	10

Notes:

NA: Not applicable

¹Data based on ENVIRON's review of the analytical results found in Tables B-1 and B-19 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).

TABLE 18 Summary of Analytical Data for Total Cadmium in Groundwater Monitoring Wells, Himco Landfill ¹								
Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCP1	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	12	6	4	3	7	5	6	5
Number of Detects	0	0	0	1	1	1	1	0
Range of Detected Concentrations (µg/L)	NA	NA	NA	1.7	3.0	1.1	2.4	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	1 to 5	1.1	1 to 5	1.1	1 to 5	1.1	1 to 5	1.1
Notes: NA: Not applicable ¹ Data based on ENVIRON's review of the analytical results found in Tables B-3 and B-21 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).								

TABLE 19

Summary of Analytical Data for Nitrogen, Nitrate, and Nitrite in Groundwater Monitoring Wells, Himco Landfill¹

Sampling Information	Background Wells		On Landfill Wells		South Landfill (Shallow Wells)		South Landfill (Deep Wells)	
	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data	RI Sampling Data	New Sampling Data
Well IDs	WT102A, WT102B, WT102C, WTB1, WTB2, WTB3, WTB4	WT102A, WT102B, WT112A, WT112B, WT113A, WT113B	WT103A, WTCPI	WT01, WT114A, WT114B	WT101A, WT111A, WTE2, WTM2	WT101A, WT111A, WT115A, WT116A, WT117A	WT101B, WT101C, WTE3, WTM1	WT101B, WT116B, WT117B, WT118B, WTE1
Number of Samples	8	NA	1	NA	5	NA	5	NA
Number of Detects	2	NA	0	NA	4	NA	1	NA
Range of Detected Concentrations (µg/L)	5,500 to 6,900	NA	NA	NA	50 to 280	NA	480	NA
Sample Quantitation Limits for Nondetect Samples (µg/L)	20 to 40,100	NA	20	NA	40,100	NA	20	NA

Notes:

NA: Not applicable

¹Data based on ENVIRON's review of the analytical results found in Tables B-5 and B-23 of the Remedial Investigation Report (Volume 4 SEC Donohue, 1992). ENVIRON noted several discrepancies between its summary of the analytical data and Life Systems' summary of the analytical data found in Tables A1-3, A4-8, A4-9, and A4-10 (Volume 5 SEC Donohue, 1992).

<p align="center">TABLE 20 Excess Lifetime Cancer Risk (LCR) Values Estimated by Life Systems for Four Hypothetical Locations of Ground Water Exposure</p>					
Detection Group	Chemical of Potential Concern	LCR Values for Respective Groundwater Exposure Locations			
		Background ¹	On Landfill ²	South Landfill (Shallow) ³	South Landfill (Deep) ⁴
Background only	Bromodichloromethane	8.06E-06	3.02E-05	7.04E-06	7.03E-06
Group Subtotal		8.06E-06	3.02E-05	7.04E-06	7.03E-06
Background, leachate and any well	Bis(2 ethylhexyl)phthalate	4.40E-06	3.10E-06	8.20E-06	5.10E-07
	Chloroform	8.31E-06	6.20E-05	8.30E-06	7.30E-06
	Methylene Chloride	1.51E-06	2.81E-05	2.71E-07	6.02E-07
	Trichloroethene	7.10E-07	6.04E-05	1.21E-06	1.21E-06
	Arsenic, total	9.01E-05	3.00E-04	5.01E-04	1.00E-04
	Beryllium, total	5.00E-04	2.00E-01	2.00E-04	1.80E-04
Group Subtotal		6.05E-04	2.00E-01	7.18E-04	2.90E-04
Soil only	1,1-Dichloroethene	0.00E+00	2.92E-04	5.05E-05	5.04E-05
	1,4-Dichlorobenzene	0.00E+00	2.10E-06	1.08E-06	1.08E-06
	4,4-DDE	NA	1.30E-06	1.10E-06	2.40E-07
Group Subtotal		0.00E+00	2.95E-04	5.27E-05	5.17E-05
Leachate only	4,4-DDT	0.00E+00	1.40E-06	2.70E-07	2.70E-07
	Aldrin	NA	2.00E-05	5.01E-06	5.01E-06
	Benzo[a]pyrene	0.00E+00	5.00E-04	7.00E-04	7.00E-04
	Benzo[b]fluoranthene	0.00E+00	7.00E-04	7.00E-04	7.00E-04
	Benzo[k]fluoranthene	0.00E+00	3.00E-04	7.00E-04	7.00E-04
	Chrysene	0.00E+00	5.00E-04	7.00E-04	7.00E-04
	Indeno[1,2,3 cd]pyrene	0.00E+00	3.00E-04	7.00E-04	7.00E-04
	Styrene	0.00E+00	1.15E-06	2.28E-06	2.28E-06
	Tetrachloroethene	0.00E+00	1.15E-05	3.30E-06	3.30E-06
	Vinyl Chloride	NA	8.04E-04	1.31E-04	1.31E-04
	alpha Chlordane	NA	3.30E-05	2.30E-05	3.30E-05
	beta BHC	NA	1.02E-06	5.10E-07	5.09E-07
	Dieldrin	NA	1.02E-05	4.06E-05	9.10E-06
	gamma Chlordane	NA	4.40E-07	3.30E-06	3.30E-06
	Heptachlor	NA	3.03E-06	1.01E-06	1.01E-06
Group Subtotal		0.00E+00	3.19E-03	3.71E-03	3.69E-03
Leachate and any well	Benzene	0.00E+00	4.03E-05	3.02E-06	4.03E-06
Group Subtotal		0.00E+00	4.03E-05	3.02E-06	4.03E-06
Grand Total		6.13E-04	2.04E-01	4.49E-03	4.04E-03

¹Data based on two samples taken at each of seven wells: WB1, WB2, WB3, WB4, WTP102A, WTP102B, WTP103C. Risks compiled from Appendix 5, pp. A5-230 and A5-231 (Volume 5, SEC Donohue, 1992).

²Data based on one leachate sample taken at trench TL1, one at trench TL2, either one or two at trench TL4, and two groundwater monitoring well samples each taken at wells WTCP-1 and WT-103A. Risks compiled from Appendix 5, pp. A5-128 and A5-129 (Volume 5, SEC Donohue, 1992).

³Data based on one sample taken at well WT-101A and two samples taken at each of three wells: WTE-2, WTM-2 and WT-111A. Risks compiled from Appendix 5, pp. A5-156 and A5-157 (Volume 5, SEC Donohue, 1992).

⁴Data based on one sample taken at well WTE-3 and two samples taken at each of three wells: WTM-1, WT-101B and WT-101C. Risks compiled from Appendix 5, pp. A5-201 and A5-202 (Volume 5, SEC Donohue, 1992).

TABLE 21
Noncancer Hazard Quotient (HQ) Values Estimated by Life Systems for Four Hypothetical Locations of Ground Water Exposure

Detection Group	Chemical of Potential Concern	Non-Cancer HQ Values for Respective Groundwater Exposure Locations			
		Background ¹	On Landfill ²	South Landfill (Shallow) ³	South Landfill (Deep) ⁴
Background and any well	Nitrite/Nitrate ⁵	2	0.0	5	0.1001
Group Subtotal		2	0.0	5	0.1001
Background, leachate and any well	Antimony, Total	3	406	1	2
	Barium, Total	0.071	0.0303	0.0706	0.0807
	Chromium, Total	0.104	20	0.306	0.0407
	Silver, Total	0.083	0.0305	0.0508	0.0407
	Vanadium, Total	0.054	9	0.208	0.042
Group Subtotal		3	436	2	2
Leachate only	Carbon Disulfide	0.0	1	0.09103	0.08103
Group Subtotal		0.0	1	0.09103	0.08103
Leachate and any well	Cadmium, Total	0.0	60	0.1009	0.1009
Group Subtotal		0.0	60	0.1009	0.1009
Any well	Chlorobenzene	0.0	0.02208	0.0572	0.0562
Group Subtotal		0.0	0.02208	0.0572	0.0562
Grand Total		5	497	7	3

¹Data based on two samples taken at each of seven wells: WB1, WB2, WB3, WB4, WTP102A, WTP102B, WTP103C. Risks compiled from Appendix 5, pp. A5-230 and A5-231 (Volume 5, SEC Donohue, 1992).

²Data based on one leachate sample taken at trench TL1, one at trench TL2, either one or two at trench TL4, and two groundwater monitoring well samples each taken at wells WTCP-1 and WT-103A. Risks compiled from Appendix 5, pp. A5-128 and A5-129 (Volume 5, SEC Donohue, 1992).

³Data based on one sample taken at well WT-101A and two samples taken at each of three wells: WTE-2, WTM-2 and WT-111A. Risks compiled from Appendix 5, pp. A5-156 and A5-157 (Volume 5, SEC Donohue, 1992).

⁴Data based on one sample taken at well WTE-3 and two samples taken at each of three wells: WTM-1, WT-101B and WT-101C. Risks compiled from Appendix 5, pp. A5-201 and A5-202 (Volume 5, SEC Donohue, 1992).

⁵Although leachate was sampled for nitrite/nitrate, sampling results were qualified with an "R" flag indicating that the results are unusable.

APPENDIX A
Ground Water Sampling Data
Obtained by USEPA Region V